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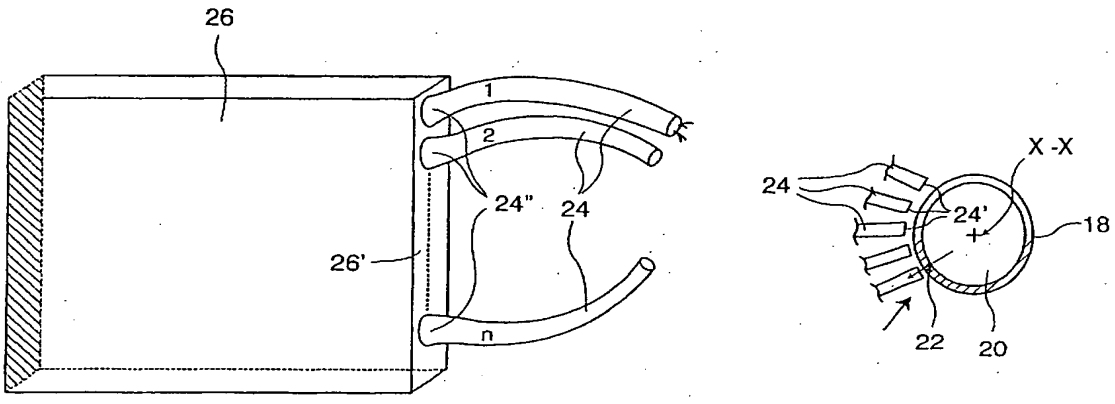
(54) Title: SCROLLING BACKLIGHT SYSTEM AND DISPLAY PANEL



(57) Abstract: Backlighting is provided for a display panel display by directing light from a source (10) via rotating means (16, 30) to plurality of optical wave guides (24) which are positioned with one end (24') towards said means and the other end (24") attached along one edge (26') of the panel (26) to which backlighting is provided. The beam is rotated providing light sequentially to each of the wave guides (24) with resulting scrolling of the light across the panel (26) behind the display panel array.

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Scrolling backlight system and display panel

TECHNICAL FIELD

This invention relates generally to improvements in scrolling backlighting systems of the type used in display applications for motion artifact reduction and, more particularly, to the invention resides in apparatus for scrolling high intensity light from a source over a backlight panel for an LCD-TV display in a manner which overcomes problems normally associated with scrolling backlight systems.

The invention further relates to a panel comprising such a backlighting system.

BACKGROUND TECHNOLOGY

In the transmitting mode of operation of a LCD, light emanating from an appropriate light source is directed to a panel located on the opposite side of the LCD display from the viewer.

In order to reduce motion artifacts in LCD-TV displays, it has been found useful to provide the light in such a manner that a beam is continually scrolled over the panel. Presently, scrolling backlight systems used in the reduction of motion artifacts for LCD-TV use either direct backlight cold cathode fluorescent lamps (CCFLs) or edge-backlight white RGB (red, green, blue) LEDs, the latter of which requires substantially more power than the former. Both systems commonly experience undesirable characteristics such as non-uniformity of illumination over the area of the panel and/or brightness level.

The present invention is directed to overcoming one or more of the problems or disadvantages associated with the relevant technology.

SUMMARY OF THE INVENTION

Light from an appropriate source is directed into

a) a light source (10);

b) rotating means (16, 30) for directing light into a plurality of optical wave guides (24) each having a proximal (24') and a distal (24") end;

c) said proximal ends being arranged in facing relation to said rotating means.

d) said distal ends (24") being arranged linearly along one edge (26') of said panel (26) and

e) motive means (28) for imparting rotation to said rotating means.

In one embodiment light is directed into the open end of a cylindrical drum, the other end of which is closed. The drum has a highly reflective inside surface and an orifice of predetermined dimensions in the cylindrical wall. The drum is rotated at constant angular velocity about its axis, causing the beam of light passing through the orifice to likewise rotate in a circular pattern. An array of optical fibers is arranged with a proximal end of each fiber positioned on a circle coaxial with the axis of the drum and spaced outwardly from the position on the drum's outer surface which includes the orifice. The distal ends of the fibers are positioned linearly along an edge of the backlighting panel of e.g. a LCD array with the distal ends in the same sequence as the proximal ends. Thus, the beam passes through the orifice and sequentially impinges upon the proximal ends of the fibers, and is thereby directed to and scrolled continuously across the panel to provide backlighting with a sufficient and uniform level of brightness.

In a further embodiment a transparent stating body directs the light beam into a stack of wave-guides, the distal ends of which are positioned along the edge of the backlighting panel of a transmissive display panel.

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 is a somewhat diagrammatic, perspective view of certain elements of apparatus embodying the invention; and

Figure 2 is a perspective view of portions of the apparatus of Figure 1, with one element in section, in combination with other elements which form a part of the invention.

Figure 3 is a perspective view of a further embodiment.

BEST MODE FOR CARRYING OUT THE INVENTION

Referring now to the drawing, light emitted by high intensity light source 10 is directed by parabolic reflector 12 into open end 14 of drum 16. In projector applications a high intensity discharge lamp, such as a metal halide lamp, is preferred for light source 10, while in other applications a different type of bulb or lamp may be preferable. Cylindrical wall 18 concentrically surrounds drum axis X-X and end wall 20 closes the end opposite

open end 14. The internal surfaces of walls 18 and 20 are highly reflective and designed to guide light toward outcoupling orifice 22 in drum wall 18.

A plurality of incoupling fiber optic light guides 24 are positioned with the proximal end 24' of each guide positioned on a circle coaxial with axis X-X, in facing relation and close proximity to wall 18 in the plane of orifice 22. Distal ends 24" of guides 24 are connected to edge 26' of panel 26 in a linear array in the same sequence as proximal ends 24' are positioned about axis X-X. The number of guides 24 is preferably greater than the number of inches in the length of side 26'. For example, sixteen or more guides would be provided for a 15" panel, although this would of course be dependent upon details of panel design and light guide physical parameters.

FUNCTIONAL DESCRIPTION

In operation, rotation is imparted to drum 16, e.g., by motor 28, at a constant angular velocity W_r. Thus, the beam of light passing through orifice 22 is likewise rotated about axis X-X and sequentially scanned over ends 24' of fibers 24. The dimensions of orifice 22 and the positioning of fiber ends 24' are such that the beam is scanned across the full surface of each of the fiber ends, one at a time in the sequence 24_1-24_n in which the ends are positioned about the drum. The light is conducted by the fibers to and through distal ends 24", which are arranged along edge 26' in the same sequence 24_1-24_n, thereby providing scrolled backlighting to panel 26 with illumination at an acceptable level of uniform brightness.

In Figure 3 a plurality of incoupling wave guides 24 are positioned with the proximal end 24' of each guide positioned on top of each other in facing relation and close proximity to rotating prism 30. Distal ends 24" of guides 24 are connected to edge 26' of panel 26 in a linear array in the same way as described with reference to Figures 1,2.

In operation, rotation is imparted to prism 30, e.g., by a motor at a constant angular velocity (arrow 31). Thus, the beam of light passing lens through 33 prism 30 is likewise rotated (arrow 34) about axis X-X and sequentially scanned over ends 24' of fibers 24. The dimensions and the positioning of wave guide ends 24' are such that the beam is scanned across the full surface of each of the wave guides ends, one at a time in the sequence $24_1 - 24_n$ in which the ends are positioned on top of each other. The light is conducted by the wave guides to and through distal ends 24", which are arranged along edge 26' in the same sequence $24_1 - 24_n$, thereby providing scrolled backlighting to panel 26 with illumination at an acceptable level of uniform brightness.

Instead of a (transparent) prism after elements like cubes or pentagons may be used.

Other aspects and features of the present invention can be obtained from a study of the drawings, the disclosure, and the appended claims. For instance, other transparent display effects may be used in panel 26.

CLAIMS:

1. A scrolling backlighting system for a transmissive display panel, said system comprising:

a) a light source (10);

b) rotating means (16, 30) for directing light into a plurality of optical wave guides (24) each having a proximal (24') and a distal (24") end;

c) said proximal ends being arranged in facing relation to said rotating means.

d) said distal ends (24") being arranged linearly along one edge (26') of said panel (26) and

e) motive means (28) for imparting rotation to said rotating means.

2. The backlighting system of claim 1 wherein said light source (10) is a high intensity discharge lamp.

3. The backlighting system of claim 1 wherein said motive means (28) rotate said rotating means (16) at a constant angular velocity (W_r).

4. A scrolling backlighting according to claim 1 carrying an LCD display, said system comprising:

a) a light source (10);

b) a drum (16) having a cylindrical side wall (18) with a central axis (x-x), an end wall (20) closing one end of said drum, the other end (14) being open, said side and end walls having highly reflective internal surfaces, and an orifice (22) of predetermined dimensions extending through said side wall;

c) a reflector (12) positioned to reflect light from said source into said open end of said drum;

d) a plurality of n optical fibers (24) each having a proximal (24') and a distal end (24");

e) said proximal ends (24') being arranged on a circle coaxial with said central axis (x-x) in outwardly facing relation to said drum (16) in the plane of said orifice in a sequence 1 through n;

f) said distal ends (24") being arranged linearly along one edge (26') of said panel (26) in said sequence 1 through n; and

g) motive means (28) for imparting rotation to said drum about said central axis, whereby a beam of light from within said drum (16) passes through said orifice (22) and sequentially impinges on said proximal ends (24') of said fibers for transmission thereby to said proximal ends (24") in said sequence 1 through n and thence to said panel (26) to provide scrolling backlighting illumination for said LCD display.

5. The backlighting system of claim 4 wherein the number of said optical fibers (24) is greater than the number of inches in the length of said one side (26') of said panel (26).

6. The backlighting system of claim 1 comprising a lens the rotating means being transparent and comprising one of a rotating prism, a rotating cube and a rotating pentagon.

7. A display device comprising a backlighting system according to claim 1.

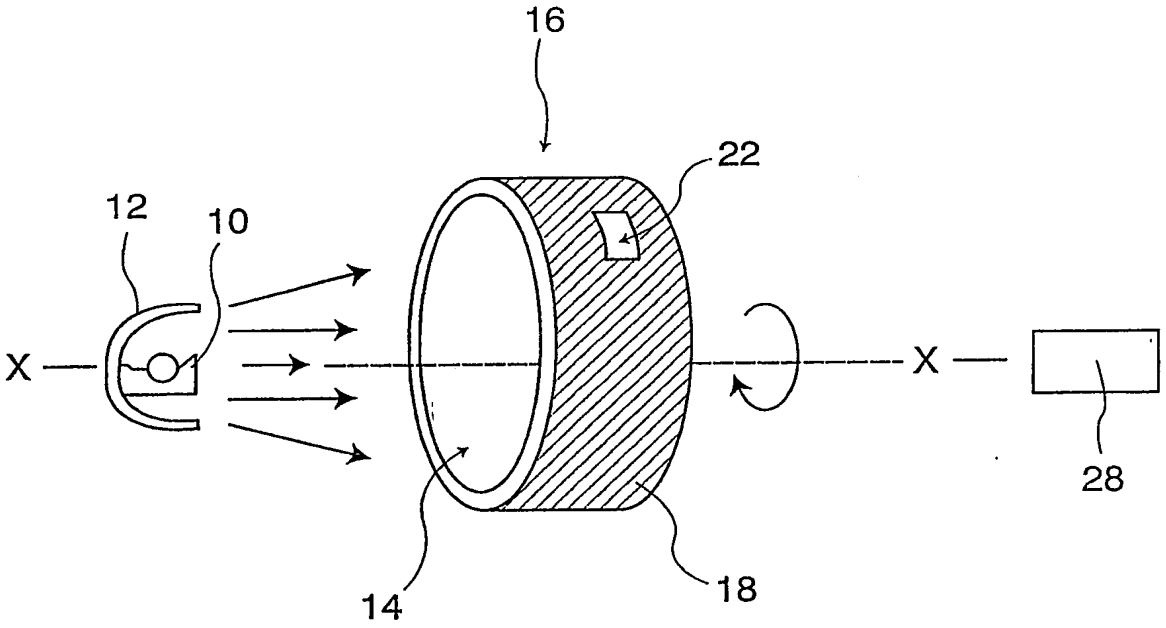

FIG.1

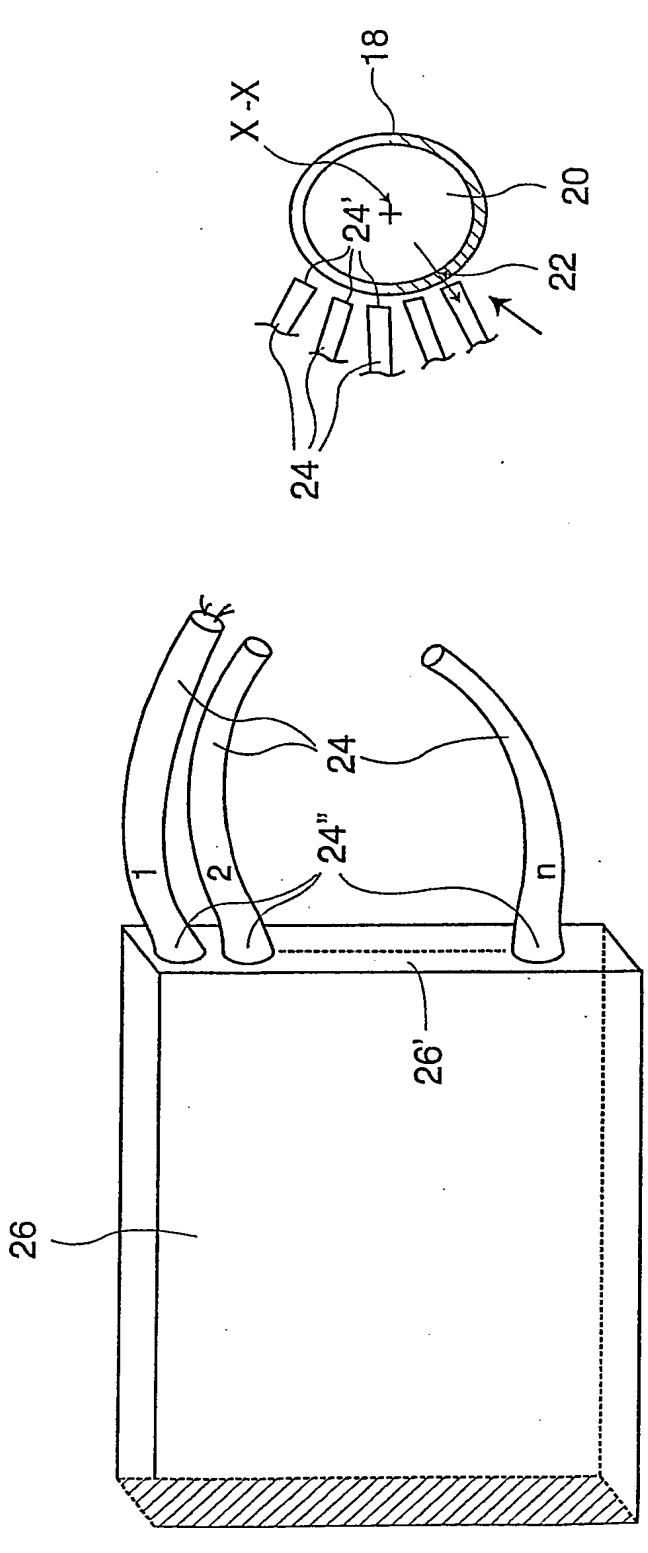

FIG.2

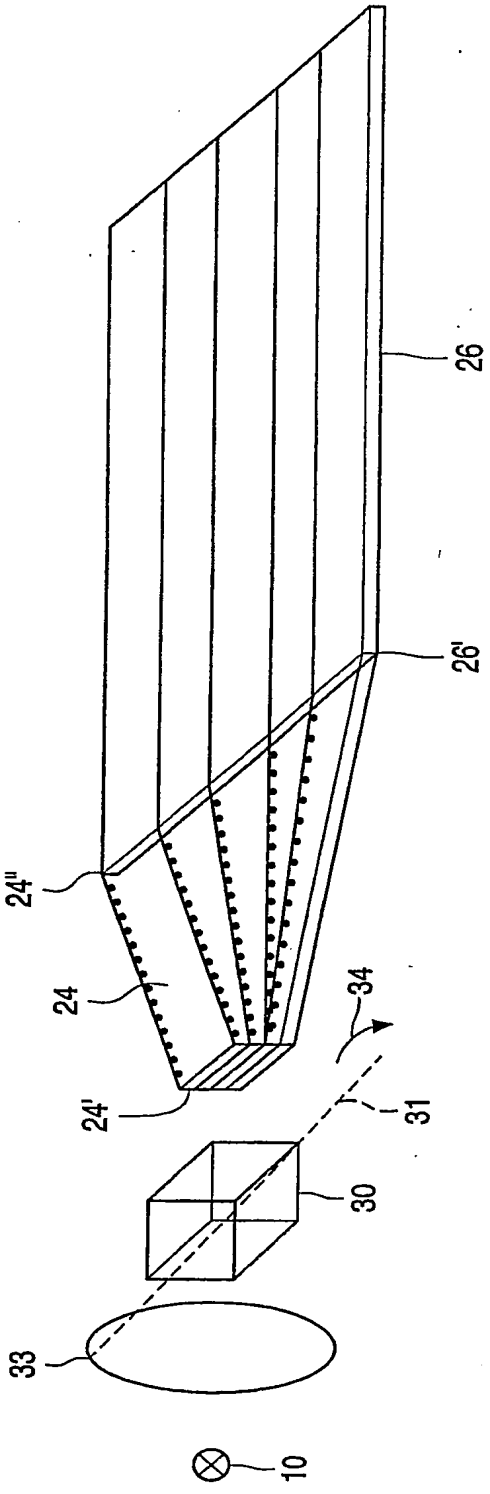

FIG. 3

INTERNATIONAL SEARCH REPORT

Intern Application No
PCT/IB 02/04377

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 F21V8/00 G02F1/13357

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 F21V G02F

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)
EPO-Internal, WPI Data, PAJ

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 6 259 496 B1 (KASHIMA KEIJI) 10 July 2001 (2001-07-10) abstract figure 10	1-7
A	US 5 365 413 A (KRAMMER GERT) 15 November 1994 (1994-11-15) abstract column 3, line 40 -column 4, line 16 figure 1	1-7

☐ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

° Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
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Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	Bagge Af Berga, H

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